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RESEARCH PLAN

ON

ENHANCING THE PERFORMANCE OF COGNITIVE WIRELESS SENSOR NETWORKS WITH ENERGY HARVESTING

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INTRODUCTION

In order to handle issues related to spectrum shortage Cognitive Radio Networks were proposed. And it was observed that spectrum sensing is the key feature for the practical deployment of Cognitive Radio Networks [1]. Adding cognition to the existing Wireless Sensor Networks or using numerous tiny sensors (similar to the idea presented for Wireless Sensor Network-WSN) in Cognitive Radio Network bring about many benefits [2].The intellectual radio is a shrewd remote correspondence framework that knows about its surrounding physical condition and under a specific strategy can utilize accessible range quickly without meddling with the essential client who paid to be served in that area. The fundamental element of Cognitive Radio that differentiate it from established systems is that it finds the spectrum gaps and powerfully modify its parameter and utilize it.

Wireless energy harvesting can improve the performance of Cognitive Wireless Sensor Networks (CWSNs)[1,2].The above mentioned fact was strengthen by observing a Cognitive Radio Network with an energy harvesting secondary transmitter improving on both energy efficiency and spectral efficiency[3].In the Adhoc structure of communication were battery consumption is one of the major issues in Adhoc/mobile devices an energy efficient cognitive radio is must[4].In order to maintain long lasting energy harvesting sensor node and maximum throughput medium access control protocols are required[5].Due to the variable spectrum availability in Cognitive Radio Networks, design of protocols and schemes at different layers of Secondary user's network have been challenging[6,7].Before going into the depth it is better to understand first, energy harvesting in conventional Wireless Sensor Networks .

Wireless Sensor Network (WSN) is a salient technique for information gathering with a wide range of applications including battlefield surveillance, intelligent building, habitat monitoring etc[8] . In general, the small-sized and battery-powered sensors are deployed and intended to operate unattended for a long operation time. Due to the limitation of battery capacity, the depletion of sensor's energy may lead to coverage hole and network partition[8,9]. Recently, the energy harvesting technology proposes a promising solution to prolong sensor's lifetime by enabling the sensors to harvest energy from the ambient energy sources, such as thermal, wind and Radio Frequency (RF) [6] . The typical application of the energy harvesting radio sensor network is reported in [10] , where Dutta et al. deploy a solar-powered sensor network to monitor the outdoor environment for more than four months.

Although, the ambient energy can be harvested and stored for later use, the availability of ambient energy sources is temporally and spatially changing [11] . Therefore, the energy harvested and consumed by sensors should be well balanced to promise the sensor's sustainability and functioning [8,11].

In Wireless Sensor Network ,deployment of nodes and routing protocols for data transfer are application specific. Various routing protocols have been proposed earlier to increase the life time of network. For better outcome a routing strategy is to be adopted to route data to central collection points .For tree topology based data collection each node have to transmit data to its descendants and node with large number of nodes as descendants will lose energy quickly. Therefore every node is brought together with their neighboring nodes to form a cluster and a cluster head is designated only which can collect data from different nodes and communicate with base station. The grouping of nodes can be done under homogenous grouping plan or alternatively heterogeneous grouping plan. The conventions for information steering utilized as a part of homogeneous grouping plans, for example, LEACH[10], PEGASIS[8], APTEEN[11] although they do not function admirably for the heterogeneous networks. Hence there is a requirement for heterogeneous mindful conventions for proficient utilization of energy and consequently increment organize lifetime.

LITERATURE SURVEY

Various aspects of Cognitive radio ,Cognitive Wireless Sensor Network ,Conventional Wireless Sensor Networks ,Energy harvesting techniques etc have been studied during my literature survey. Compiled details of the same are given below:-

Morteza Tavana et.al [1] described Cooperative spectrum sensing with detection based on two summary statistics, including energy and first order correlation of the received samples of the signal. The probabilities of detection and false alarm are obtained as criteria for evaluating the performance of the Cognitive Radio Networks. The performance evaluation is presented through simulations.

Mateen Ashraf et al[2] discussed that Wireless energy harvesting can improve the performance of Cognitive Wireless Sensor Networks (CWSNs). This article considers radio frequency (RF) energy harvesting from transmissions in the primary spectrum for CWSNs.

The overall success probability of the energy harvesting cognitive WSN depends on the transmission success probability and energy success probability.

Sungsoo park et al [3] derived the optimal detection threshold that maximizes the expected total throughput subject to the energy causality constraint and the collision constraint. He had also shown that a decreasing probability of accessing the occupied spectrum does not always result in decreased probability of accessing the idle spectrum in the energy-limited regime.

Muhammad Talha Zia[4] proposed technique of opportunistically acquiring radio channel without creating interference in the licensed user activity is taken under consideration and focused as the main idea in his survey. This survey expose the energy efficiency of different CR MAC protocol techniques.

Chul wan park et al [5] presented an efficient sensing mechanism and a contention algorithm for a Cognitive Radio Network with energy-harvesting nodes. Simulation results were obtained for various performance parameters of Cognitive Radio Network to exhibit the effects of energy harvesting.

Hasan A. A. Al-Rawi et al [6] presented performance enhancements achieved by the existing routing schemes in CRNs. Finally, he discuss various open issues related to routing in CRNs in order to establish a foundation and to spark new interests in this research area.

Gayathri Vijay et al[7] provided the vision and advantage of a holistic approach to cognition in sensor networks, which can be achieved by incorporating learning and reasoning in the upper layers, and opportunistic spectrum access at the physical layer. This paper provides the reader with a framework based on knowledge and cognition that can help achieve end-to-end goals of application-specific sensor networks.

Anfeng liu Et al.[8] in this paper, cost function energy-aware routing have been studied. The general principles of cost function design and evaluation criteria were proposed. Further, two novel energy aware cost based routing algorithms, named exponential and sine cost function based routing (ESCFR) and double cost function based routing (DCFR)were proposed.

Imran Ahmed et al.[9] summarized all the major research work in the area of energy harvesting resource allocation and outlines the key areas for future research.

Prabal Dutta et al[10] discovered many flaws with network management ,power management and networking software by experiencing with a large scale long lived outdoor sensor network test bed.

Y.Zhang et al[11]discussed optimum data transmission schedules of the sensor has been explored to maximize the theoretical communication channel capacity for fading communication channels, where convex optimization techniques are used in order to get optimal data transmission and energy allocation policies.

RESEARCH GAP

Remote sensor networks consist of a number of sensor nodes that sense various parameters such as temperature, pressure, etc from an environment they are deployed in, perform data aggregation and send the data to the user application that makes use of it to detect the conditions in that environment .However there is one factor that chooses the utilization of CWSN: the energy. Since every sensor hub needs to perform activities of gathering, totaling and exchanging of information they require some source of energy to drive the system. As of now they get their energy from the batteries which can give restricted measure of energy. Thus different energy productive directing conventions/protocols have been proposed which help in least energy utilization guaranteeing longer solidness period which thusly expands the lifetime of the system.

In CWSN all the nodes have power source which provide energy to participate in the network. In the basic CWSN the power source are batteries. As we know, the amount of energy that can be stored by battery is limited and cannot be rechargeable. So we should try to not waste this energy and use it in an optimized way. The aim of routing protocols is to use the battery energy in an efficient way to increase the network lifetime. Therefore target of the proposed routing algorithm should be energy consumption minimization and network lifetime maximization .While routing grouping of nodes can be done in homogenous and heterogeneous manner. Various routing protocol such as LEACH, PEGASIS, TEEN,

APTEEN are there but they do not perform well in heterogeneous grouping .A heterogeneous WSN is one where every node has different amount of energy associated with it before being deployed in a network .In my research work I will produce simulations using MATLAB prove that protocols like HEEPSCC protocol(Hybrid Energy Efficient Protocol for Stable Concentric Clustering) causes less energy consumption in heterogeneous grouping. I will try to develop new efficient algorithm for better coordination of mobile sinks, balanced energy consumption of sensor nodes, and to address other issues.

RESEARCH OBJECTIVES

With the aim of contributing towards the deployment of energy efficient cognitive wireless sensor networks the following objectives are proposed for my research work.

1.To develop an energy efficient cognitive wireless sensor network the proposed work will give a detailed simulation study of the energy harvesting process in cognitive wireless sensor networks (which will eventually exhibit the increase in lifetime of the network to maximum extent).

2.In order to show the utility of energy harvesting process its "effect on various performance parameters of a cognitive system" will be presented along with detailed study and simulation results.

3.As spectrum sensing is the key feature for the practical deployment of Cognitive wireless sensor networks hence improvement on "probability of detection" during spectrum sensing due to the development of energy efficient cognitive system will be presented along with detailed simulation results.

RESEARCH CONTRIBUTION

- A survey of the energy-aware CWSN routing algorithms of various related literatures.
- Looking for routing algorithms that can support energy efficient CWSN technologies.
- Defining analysis metrics.
- Writing codes to implement simulator by using MATLAB program.
- Simulation of network for the chosen routing algorithms.
- Behavioral analysis of the results from the simulation scenarios.
- Moving ahead towards the deployment of a Cognitive Wireless Sensor Network.

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